# Technology Opportunity

## High-Temperature Adhesive Strain Gage

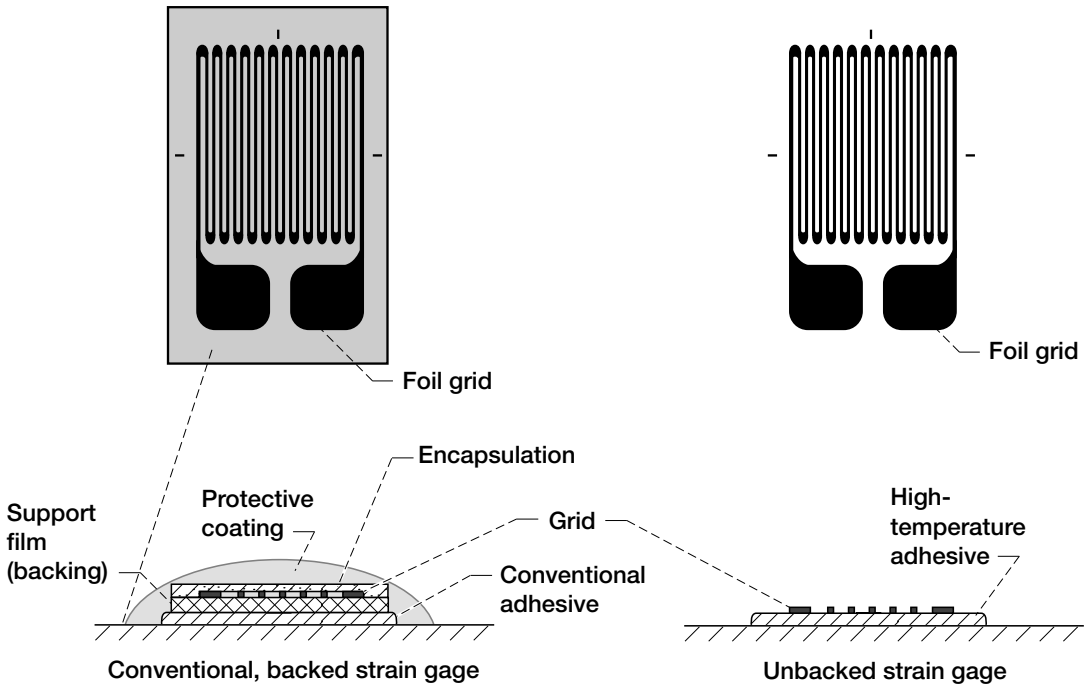
The National Aeronautics and Space Administration (NASA) seeks to transfer a recently developed adhesive strain gage system for use at temperatures exceeding 315 ºC (600 ºF).

### Potential Commercial Uses

- Elevated-temperature strain measurement of polymers and polymer composites
- Elevated-temperature strain measurement of standard materials and components
- Applications requiring low-profile strain gages (for example on fan blades where it is important not to interfere with the flow)

### Benefits

- The system can measure strains at higher temperatures than possible with commercially available systems.
- Current methods require that the adhesive be cured at a higher temperature than the maximum operating temperature of the gage. This is not required by the new system.
- The low profile of the gage minimizes interference to the part's surface. This is beneficial in certain circumstances, for example, where surface flow should not be affected.




Comparison of the conventional strain gage system with the high-temperature, unbacked system.

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## The Technology

A unique strain gage and adhesive system has been developed for measuring the mechanical properties of polymers and polymer composites at elevated temperatures. The system overcomes some of the problems encountered in using commercial strain gages and adhesives. One such important limitation of typical commercial strain gage adhesives is that they require a post-cure at temperatures substantially higher than the maximum test temperature. Exposure of specimens to such high temperatures may affect subsequent results, and in some cases may be higher than the glass transition temperature of the polymer. In addition, although typical commercial strain gages can be used for short times at temperatures up to 370 ºC, their long-term use is limited to 230 ºC. This precludes their use for testing some high-temperature polyimides near their maximum temperature capability.

Our recently developed system consists of a nonencapsulated, unbacked gage grid that is bonded directly to the polymer with a specially formulated adhesive. (The figure contrasts the configuration of the system with standard gage systems.) The gage is applied after the specimen has been cured, but prior to the normal post-cure cycle. The adhesive was formulated to cure under the specimen post-cure conditions. Special handling, mounting, and electrical connection procedures were developed to ensure repeatability of results.

A variety of tests have been conducted to determine the performance characteristics of the gages on specimens of PMR-15, a high-temperature polyimide used in aerospace applications. These tests include static tension, thermal exposure, and creep tests. The gage and adhesive system performed within normal strain gage specifications at 315 ºC under these conditions.

## Options for Commercialization

Any company interested in commercializing this technology should contact NASA Lewis.

## Contacts

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## Key Words

Strain gage
High temperature
Polymers



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